

# Cost of Production

versus

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by

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## Introduction

Cost of production per unit is the cost associated with production divided by the number of units produced. The difficulty in calculating the cost of production is usually thought to be in assembling all the costs associated with production and there are volumes written about the correct procedures. However, the question of the relationship of the cost of production to the price of the product is seldom discussed. One reason for this is the relationship seems very straightforward. In single product enterprises, the cost of production can be compared directly to the price of the product, regardless of the method used to calculate the cost of production.

Determining the relationship between cost of production and the product's price in joint product enterprises is more difficult. A joint product enterprise is one in which two or more products are produced from one production practice and the costs associated with the production of each individual product can not be measured with existing information.

This paper will look at some methods commonly used to calculate the cost of production. The pros and cons of each method will be discussed. The conclusion will argue for the use of one method, when an enterprise produces joint products.

## Example Enterprise

A wheat enterprise, in some parts of the world, is a joint product enterprise. The joint products are wheat grain and wheat straw. The major product is wheat grain but wheat straw can be harvested and sold, in some cases.

The facts are:

Wheat grain yield	50 bushel per acre
Wheat straw yield	0.8 tons per acre
Seed Costs	\$20.00 per acre
Fertilizer	\$40.00 per acre
Fuel	\$10.00 per acre
Chemicals	\$20.00 per acre

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Other	\$30.00 per acre
Total Operating Costs	\$120.00 per acre

Land Costs	\$50.00 per acre
Machinery	\$20.00 per acre
Labor	\$10.00 per acre
Management	\$10.00 per acre
Total Overhead Costs	\$90.00 per acre

Total Costs	\$210.00 per acre
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Wheat grain price	\$4.00 per bushel
Wheat straw price	\$50.00 per ton

Given these facts, what is the seed cost per bushel of wheat grain? What is the total operating cost per bushel of wheat grain? What is the total overhead cost per bushel of wheat grain? What is the total cost of production per bushel of wheat grain?

## Methods

### Per Unit Sold

This is the cost of production method commonly used with single product enterprises. The divisor in this method is the number of units of the major product that were produced by the single or joint product enterprise.

The main advantage of this method is it is an extension of the single product enterprise method and familiar to most individuals so knowledge of another method is not required. Also, it is easy to determine the divisor, just use the number of units of the major product produced. In this example that number is 50. In addition, it seems as if you don't need to know the price of the outputs to calculate the cost of production.

The problems with this method are determining the cost per unit of individual expense items (such as seed) and comparing the cost of production to the price received per unit. The cost of seed per bushel, using this method, would be \$0.40 (\$20 / 50). However that implicitly says that none of the seed was required to produce the straw. This is probably untrue, but usually it is not possible to separate the seed costs between those required to produce grain versus straw.

This problem, of allocating all the costs of production to the major product, continues even when all costs are considered. Using the example, the operating cost per bushel of wheat grain is \$2.40; the overhead cost of production per bushel is \$1.80; and the total cost of production per bushel is \$4.20 (\$210 / 50). This is greater than the price received per bushel (\$4.00); therefore the producer might be lead to the conclusion that the wheat enterprise is unprofitable. However, if the enterprise is examined on a per acre basis (\$240 income - \$210 costs = \$30 profit), this proves to be untrue.

This is the major problem with this method. The cost of production per unit can **not** be compared to the price received for a unit of the major product. The cost of production must be compared to some other unit of revenue. This new unit of revenue is called "Income per Unit (of major product sold)." It is calculated by adding the income from the sale of all the products and dividing by the number of units produced of the major product. In the example, the income from the sale of all the products is \$240 (wheat grain income (\$4.00 X 50 = \$200) is added to the wheat straw income (\$50 X 0.8 = \$40)). This is divided by the 50 bushels of wheat grain produced and the Income per Unit is \$4.80.

**The cost per unit is calculated using this method it must be compared to the Income per Unit, not to the price received per unit of major product sold.**

If that comparison is used (\$4.80 income per unit - \$4.20 cost per unit = \$0.60 and \$0.60 times 50 bushels = \$30 profit), the enterprise is correctly identified as profitable. The enigma is that an individual unfamiliar with the necessity to calculate "Income per Unit", will compare the cost of production calculated using this method to the price of the major product. This gives producers incorrect information on which to base production, marketing, hedging, forward contracting, or other decisions.

## **Residual Claimant**

When using this method, the income from the sale of the joint product(s) is subtracted from the total cost and the remaining cost is divided by the units produced (of the major product). In the example, \$210 cost - \$40 of straw income = \$170 of residual costs. This divided by 50 bushels of wheat grain produced to equal a total cost of production of \$3.40 cost per bushel.

This method allows the comparison between the cost per bushel and the price per bushel of wheat grain. The profit per acre is the wheat price per bushel (\$4.00) minus the cost per bushel (3.40) times the number of bushels sold (50). Doing this calculation yields a profit per acre of \$30. One of the advantages of this method is that an individual unfamiliar with its' calculation background can compare the results presented to the price of the major product.

However, it has disadvantages especially if the components of the cost of production need to be calculated. How should the operating cost of production per bushel be calculated? The operating costs were \$120 per acre. Should some of the straw income be subtracted from that value before dividing by the bushels produced? If so, how much?

This problem is further compounded if the cost of various individual cost items must be calculated. Example: what is the seed cost per bushel?

Also, this method implicitly sets the profit on all non-major products to zero.

## Equivalent Production

To use this method a new divisor must be calculated. The new divisor is the number of units of the major product the enterprise would have had to produce in order to have the same income as it has now, without the joint product(s) income. In other words, if this were not a joint product enterprise, how many units of the major would it need to produce to obtain an identical income?

The formula for calculating the equivalent units of production is:

$$\frac{\text{Total Enterprise Income (from all products)}}{\text{Price of Major Product}}$$

In the example, the equivalent bushels is 60 ( $\$240 / \$4.00$ ). In other words, this enterprise could produce 50 bushels of wheat grain and 0.8 tons of wheat straw or 60 bushels of wheat grain and have identical income.

The “equivalent units of production” instead of the actual units of production are divided into the cost items and/or categories when this method is used. The seed cost per equivalent bushel is \$0.33 ( $\$20 / 60$ ). The operating cost per bushel is \$2.00 ( $\$120 / 60$ ), the overhead cost is \$1.50 ( $\$90 / 60$ ), and the total cost is \$3.50 ( $\$210 / 60$ ). The profit to the enterprise is \$30 ( $(\$4.00 - \$3.50) \times 60$ ).

The major advantages of this method are that the cost of production can be compared to the price received for the product and that components of the cost of production can be easily calculated. Also, the cost of these components can be compared to the price of the product.

The major disadvantage of this method is that implicit in the calculation is an identity between the joint products. This calculation makes the percent profit (or loss) on each product identical. In other words, if the profit on wheat grain is 10 percent, the profit on wheat straw is 10 percent.

## Conclusions

Generally, when individuals see a cost of production value, they immediately compare it to the price of the product. Therefore the “Per Unit Sold” method can confuse producers and lead to incorrect decisions because the producer may not understand that the comparison value is Income per Unit, not the price of the product. This can lead to bad decisions if a producer is trying to determine a forward contracting or hedging strategy based on their cost of production.

The “Residual Claimant” method has limited application because it can only easily calculate the total cost of production.

The “Equivalent Production” method is the best for joint product enterprises because the cost of production can be compared directly to the price and components of the cost can be easily calculated and compared.

Note: if an enterprise has only one product, all methods produce identical results.

## Inferences

The use of an equivalent unit is the most meaningful measure when calculating the cost of producing milk, because dairy farm businesses have multiple sources of income. The measure is calculated by summing the income from the sale of all products produced on the dairy farm and dividing by the price of milk.

Dairy farms have numerous sources of income: milk, cull cows, calves, CCC milk assessment refund, cooperative dividends, property tax credit on income taxes, crop-related government payments, etc. This large number of income sources makes using an equivalent unit essential. In addition, on most dairy farms the cost of producing crops sold for cash cannot be separated from the cost of producing crops fed to the dairy herd. The farm's total income (including cash sales of crops and changes in the value of feed and cattle inventories) must be included when calculating equivalent units.

For most analysis the equivalent unit is **Hundredweight of Milk Sales Equivalent** (CWT EQ). The output measure for an individual farm is calculated with the formula:

$$\frac{\text{Total Farm Income from all Sources}}{\text{Average Price Received per Hundredweight of Milk Sold by That Farm}}$$

However, when studying a group of farms or comparing farms that may be receiving different milk prices, all producers should use the same price. Therefore the formula should be:

$$\frac{\text{Total Farm Income from all Sources}}{\text{U.S. All Milk Price per Hundredweight (for the year in question)}}$$

Note: If the income from non-dairy enterprises exceed 30 percent of total income, additional calculations to separate out the non-dairy enterprises' costs are required.